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ROCKER ARM RESISTANCE WELDER

MODELS: 4603NA/4604NA

USER MANUAL

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1 INTRODUCTION

1.1 PRELIMINARY REMARKS

CAREFULLY READ THIS MANUAL BEFORE INSTALLING AND OPERATING THE WELDER.

This manual is addressed to the factory responsible in charge who must release it to the personnel in charge of both welder installation, use and maintenance. He/she must check that the information stated on this manual and on the enclosed documents have been read and understood. The manual must be stored in a well-known place, in an easily accessible area, and must be looked up each time even little doubts should arise.

This welder has been designed for resistance welding of ferrous materials. The welder must not be used for other applications, i.e. pieces heating, mechanical working carried out by using the electrodes force. The welder has been designed for being used by an operator by means of the foreseen control devices. All modifications, even slight ones, are forbidden.

TECNA S.p.A. is not responsible for any damage to both people, animals, things and to the welder itself caused by either a improper use or the lack or the superficial observance of the safety warnings stated on this manual, nor is it responsible for damages coming from even slight tampering or from the use of not-suitable spare parts, or of spare parts other than the original ones.

1.2 SYMBOLS ON BOTH WELDER AND MANUAL

	WARNING! Important safety information enclosed in this paragraph.
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1.3 STANDARD ACCESSORIES

The welder is supplied equipped with the following accessories:

N° 1 Allen wrench set 4-5-6-8 mm.

N° 1 Socket wrench 30-32 mm.

N° 1 TE90 control unit instruction manual.

N° 1 Welder use and maintenance manual.

Check that the welder is equipped with all the standard accessories; immediately inform the manufacturer in case some components are missing or damaged.

2 TECHNICAL FEATURES

2.1 IDENTIFICATION DATA

Item	4603NA
Year of manufacturing	
Serial number	
Mains voltage	220/440 V
Mains frequency	60 Hz.
Machine supplied with voltage set for	V

2.2 ELECTRICAL DATA

Item		4603NA	4603NA	
Mains voltage	V	440	220	
Mains frequency	Hz	60	60	
Nominal power at 50% duty cycle	KVA	20	20	
Maximum welding power	KVA	50	50	
Short circuit secondary current	kA	15	15	
Maximum welding current on steel	kA	12	12	
Secondary thermal current at 100%	A	3350	3350	
Secondary no load alternate voltage	V	4.2	4.2	
Delayed fuses	A	32	63	
Mains cables section for L=10 m *	mm ² AWG	10 7	25 3	
Mains cables section for L=30 m *	mm ² AWG	10 7	35 2	
Supply transformer minimum power **	KVA	58	58	

* Section for every cable, calculated for PVC insulated, single conductor cables, considering the welder working at the maximum welding power, as well as a 4% voltage drop on cables.

** Approximate value, calculated for a three-phase transformer with a 4% short circuit voltage, with 6% voltage drop on transformer and a 4% voltage drop on cables, with the welder adjusted for the maximum welding power.

2.3 MECHANICAL DATA

Item	4603NA	
Min. electrodes throat depth	230 mm - 9 inch	
Electrode force at 6 bar (600 kPa - 87 psi)	240 daN - 528 lbs	
Max. working stroke	44 mm - 1 3/4 inch	
Max. electrodes throat depth	550 mm - 21 1/2 inch	
Electrode force at 6 bar (600 kPa - 87 psi)	95 daN - 209 lbs	
Max. working stroke	85 mm - 3 1/4 inch	
Arms diameter	40 mm	
Electrode-holder diameter	25.4 mm - 1 inch	
Electrodes cone ☐ Standard ☐ Special	2MT / 5RW	
Net weight of the machine	124 kg - 275 lbs	

2.4 COOLING CIRCUIT CONNECTION DATA

Minimum water pressure	bar kPa psi	2.5 250 36
Maximum water pressure	bar kPa psi	4 400 58
Hoses inside diameter - input/output		8 mm 3/8 inch
Minimum consumption for nominal power		180 l/h - 48 gal/h

2.5 ADDITIONAL FEATURES

Item	4603NA	
Machine painting color	☐ Standard: gray - RAL7032 ☐	
Aerial noise produced -Continuous equivalent acoustic pressure level; a weighed value (A)	dB	< 70
Measurement position	h=1.60 m L=0.5 m	
Measurement conditions		
working stroke (mm)	20	
welding time (cycles)	17	
welding current (kA)	11	
working rating (welds/min)	10	

2.6 WELDER MAIN FEATURES

- Rocker arm, foot operated spotwelder with microprocessor welding control unit.
- Adjustable arms, enabling to adjust the welder according to the work exigencies.
- Chrome-copper electrode-holders for heavy duty and long life, designed for both straight and angled assembling.
- Adjustable electrodes stroke, enabling to reach the max. working rate.
- Water-cooled transformer, with epoxy resin coated windings.
- Water-cooled arms, electrode-holders and electrodes.
- Synchronous SCR contactor insulated from cooling water circuit with protection thermostat.
- Adjustable electrodes force, a microswitch starts the welding cycle when the desired pre-set value is reached by operating the foot control.
- Foot control adjustable in length.

2.7 WELDING CONTROL UNIT TE-90 DESCRIPTION

TE-90 is a microprocessor welding control unit for single-phase resistance welders. The welding control unit is used to control the welder components and in particular, the thyristor adjusting the welding current. The TE-90 working cycle is described through 12 programming parameters.

MAIN FEATURES

- Synchronous thyristor drive, phase shift control for welding current adjustment.
- Simplified programming by means of four push-buttons.
- * *Twin pre-setting for time and current, recallable by two independent controls.*
- Slope and pulse functions.
- * *Single and automatic (repeat) operating mode.*
- Secondary current compensation function for the welding of oxidized sheets and rods.
- First phase shift delay adjustment. It enables the machine line current best balance.
- * *Control of solenoid valve 24 Vdc 7.2 W Max with protected output against short circuits.*
- "Watch-dog" safety circuit stopping the welder in case of control unit faulty operation, micro-interruptions or too high voltage drop.

For further information concerning TE-90, go to page 29.

- * **Control unit function not used on this welder.**

3 INSTALLATION

These paragraphs are addressed to the specialized personnel in charge of both welder handling and installation. The welder dimensions drawing, placed in last pages of this manual, providing useful information for carrying out these operations.

3.1 PLACE OF INSTALLATION

The welder must be installed in a position to allow the following features:

- In a controlled, enclosed environment. The welder has not been designed for being used outdoors.
- Room temperature included between 0 and 40 °C (If water is removed, storage is allowed down to 20°C below 0°); 1000 m. maximum altitudes.
- In a well ventilated area, free from dust, steam, and acid exhalations.
- The working place must be free from inflammable materials because the working process can produce spatters of melted metal.
- Around the welder there must be enough room to carry out both working and maintenance in a comfortable manner and without any risk.
- In a place with a suitable lighting system in comparison with the work to be carried out.
- The place of installation must necessarily be flat and the ground must be without unevenness which can be dangerous during the working.

If the welder is used to carry out welding processes which can cause smoke exhalations, there must be installed a proper aspirator. The welder must be carefully fixed to the floor through the proper holes placed on the welder basement. Do not install nearby the welder neither supporting tables, nor equipment limiting the approaching to the devices and/or making inaccessible or ineffectual the safety devices.

3.2 UNPACKING AND TRANSPORT

On receipt of the welder, verify the perfect integrity of the outer package; report to a responsible person in charge any possible anomalies which should be noticed. Possible damages on the outer package should arise some doubts on the integrity of its content. Remove the package and visually verify the welder integrity. Check that the welder is equipped with all the standard components; immediately inform the manufacturer in case some components are missing. All the material forming the package must be removed according to the present environmental protection regulations. The welder barycentre is high from ground. For this reason, the welder must be moved only by means of the proper attachment placed on the top of the welder. Consider the welder weight stated on the "TECHNICAL FEATURE" paragraph.

3.3 COOLING WATER INSTALLATION

For a correct cooling of the welder it is necessary clean water at a maximum temperature of 30°C at the quantity stated on the paragraph "Technical features". When connecting the unit to the water line check for dirt or packing scraps in the hoses and connect the supply to the inlet, and the drain to the outlet, this to allow that the still cool water immediately reaches the parts of the welder most subject to heating. Different cooling circuit systems are available: with city supply water, with re-circulating water, with heat exchanger (air-water) and with refrigerator. If the circuit is with city supply or refrigerator and you are working in presence of high humidity, we suggest to avoid the use of low temperature water, as this could produce moisture inside the machine. In presence of hard water it is necessary to install a water softener at the cooling circuit inlet hose, this to avoid that deposits obstruct or reduce the water channels in the welder, thus causing damages. If the machine is operated in a re-circulating water supply, the water softener must be placed on the supply of the cooling water tank; the insertion before the machine generates damages.

3.4 ELECTRICAL INSTALLATION

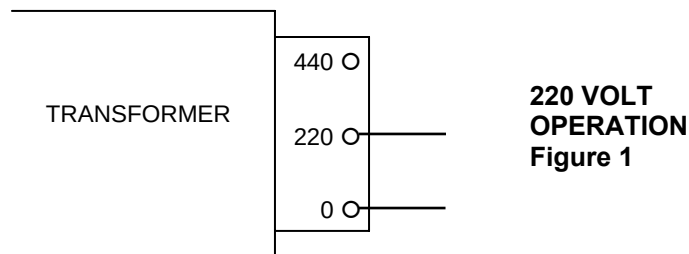
Installation must be carried out by specialized personnel only, and must adhere to all local safety rules. As this unit can be supplied for different power supply versions, before connecting the unit to the power line, check if the voltage

shown on the features plate corresponds to the one of your power supply. Consult the "technical features" paragraph to determine the cables section to be used, according to their length. On this paragraph you find also the values of the fuses which must be placed on the welder supply input. Fuses must be delayed type only. Connect machine to earth by using a cable having the same section of the mains cable. In order to facilitate the maintenance operation, we recommend you to supply the welder machine by means of a mains disconnecting switch. The welder has been designed for work with voltages of 220 or 440 supply. It is shipped with the voltage marked on the back and data plate of the machine. If you desire a different voltage you must follow the following instructions.

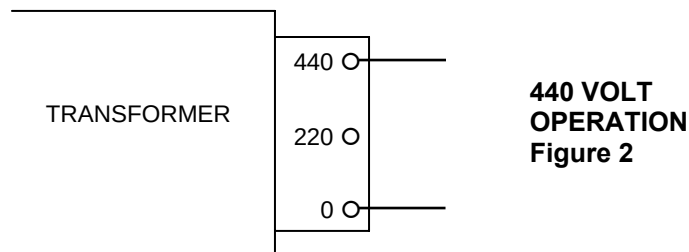
TRANSFORMER AND CONTROL VOLTAGE CONNECTIONS

WELD TRANSFORMER WIRING

The transformer your 4603NA is equipped is capable of 220 or 440 volt operation. To change the transformer voltage you must insure that the wire are on the correct taps. For 220 volt operation be sure that the two wires are on the lower two terminals marked 220V and 0V as shown in figure one.



For 440 volt operation connect the two wires to the outer most terminals marked 440V and 0V as shown in figure two.



The common wire remains the same for both voltages.

CONTROL TRANSFORMER CONNECTIONS

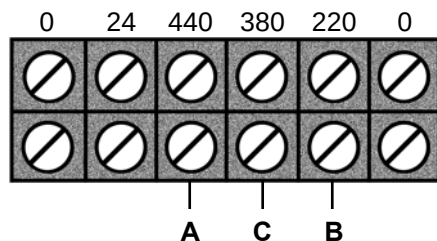


FIGURE 3 - Six terminal barrier (mounted on the top of the control transformer)

To change voltage, loosen screw terminals and insert wire into the position that matches your line voltage.

To set the voltage on the control transformer follow the directions:

1. Locate the control transformer located on the back of the control panel.
2. For 440 volt operation there must be a wire install in position "A" (see FIGURE 3). If the wire is not installed in position "A" remove the wire from position "B" or "C" and reinstall it in position "A".
3. For 220 volt operation the wire must be installed in position "B" (see FIGURE 3)

The wire must be installed in position "A" or position "B" not in both.

The position of the labeled wire are not to be changed. The only wire you can change is on the opposite side of the labeled wires on the Terminal Barrier.

4 WORKING PROCESS

The welder has been designed for being used by an operator placed in front of the unit and operating on the welder same working plane. When arranging the working place, always follow the herewith stated instructions:

- Use a well ventilated area, free from dust, steam, and acid exhalations.
- The working place must be free from flammable materials because the working can produce spatters of melted metal.
- Around the welder there must be enough room to carry out both working and maintenance in a comfortable manner and without any risk.
- If the welder is used to carry out welding processes which can cause smoke exhalations, there must be installed a proper aspirator.
- Do not install on the welder neither supporting tables nor equipment which either limit the approaching to the devices or make inaccessible or ineffectual the safety devices.

Before starting the working process, carry out the following adjustments:

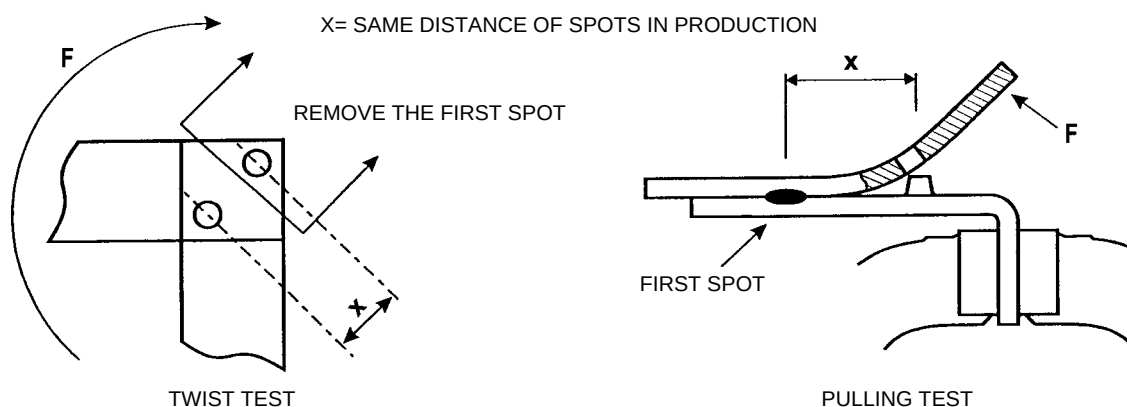
- 1- Mechanical set-up
- 2- Electrode force adjustment
- 3- Welding parameters adjustment
- 4- Calculation of the maximum welding rating

The following paragraphs carefully explain these different phases.

Before starting the working process:

- Check that all the safety instructions have been operated.
- Make sure that the microswitch is triggered at least 1 inch before the pedal touches the ground.

Before starting the welding process, check the welding conditions (time, pressure, etc.). Use two off-cuts of the sheet to weld, carry out two spots at the same distance used during the production, then remove the first and check the second: the spot is correct when the pulling test causes the coming out of the weld nugget with the hole of a sheet, and the twist test shows a pure area without porosity or causes the coming out of the nugget.



During the production it is advisable to monitor those parameters which can alter the working conditions, and thus the welds quality.

Always monitor the electrodes which must always be clean, without any deformation and must have the proper diameter according to the work to be carried out. Check that there is not strong changing in the welder supply pressure as this could modify the force on the electrodes and thus the welding quality.

Do not use sealing products to remove water losses on the electrodes conic connection. To facilitate the electrode removal and to prevent from both cone seizure and water losses, use high conductivity grease similar to the standard one. The cooling water must circulate inside the welder for a few minutes after having completed the production in order to allow the welder cooling. To prevent from both losses and moisture deposits, do not leave the cooling circuit open when the unit is not used.

Electrodes must not be used to force the clamping of the pieces to weld.

We recommend you to notice the adjustments carried out for each type of piece. In order to make it easier, a specific table has been added at the end of this manual.

4.1 MECHANICAL SET UP

Arms and electrodes adjustment

The arms length can be adjusted in comparison with the different working exigencies. The lengthening of the arms causes a decreasing of the performances, so that it is advisable always to work with the shortest available length. Under working conditions, both arms and electrodes holder must be adjusted in order to have the electrodes tip coincide. Carry out some tests with the control unit on NO WELD mode, using the same electrodes force employed to carry out the work; place among the electrodes a thickness equal to that which must be weld. If it is necessary, pull out both arms and electrodes holder and carry out the adjustment operations.

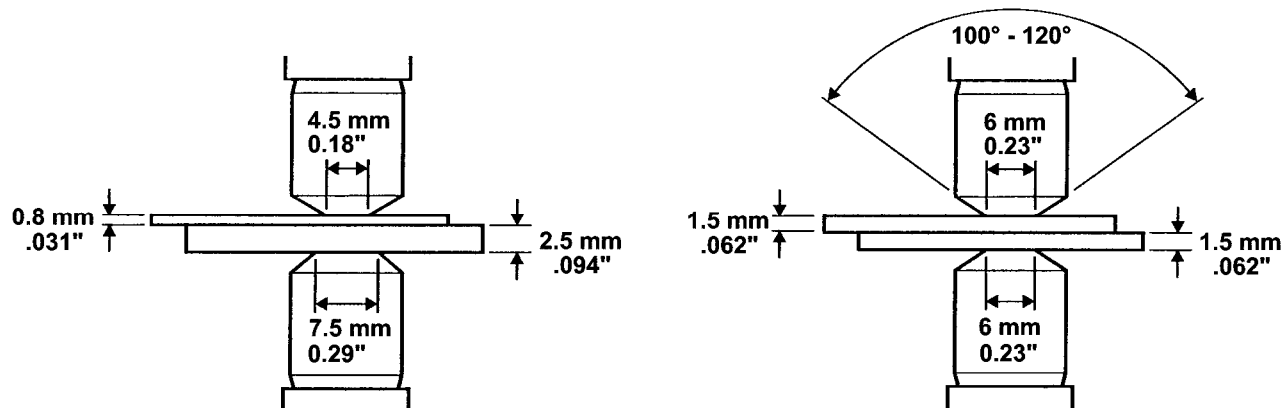
It is advisable to adjust electrodes with a fine file or with sandpaper. The best performances can be reached by using sand paper folded upon a support having the same thickness of the sheets to weld.

In case of steel welding, the electrodes diameter should correspond to the values shown on the following table.

Sheet thickness	mm inches	0.5 .021	0.8 .031	1 .040	1.5 .062	2 .078	2.5 .094	3 .109	3.5 .125
Required diameter	mm inches	4 0.16	4.5 0.18	5 0.20	6 0.23	7 0.27	7.5 0.29	8.5 0.33	9.5 0.36

Suggested electrode tip angle is 120 degrees. If the thickness of the two plates is different the electrode must have the diameter corresponding to the one required by the plate to which it gets in touch.

A too small diameter in comparison with the thickness to be welded produces spatters of melted material, sheets over mark, low spot quality. If the electrode diameter is too large, longer welding times are necessary, causing a higher heating of the welder and a shorter life of the electrodes. For aluminum spot welding we suggest to use spherical electrodes, radius value varies according to the thickness to be welded and to the kind of quality required.



Working Stroke Adjustment

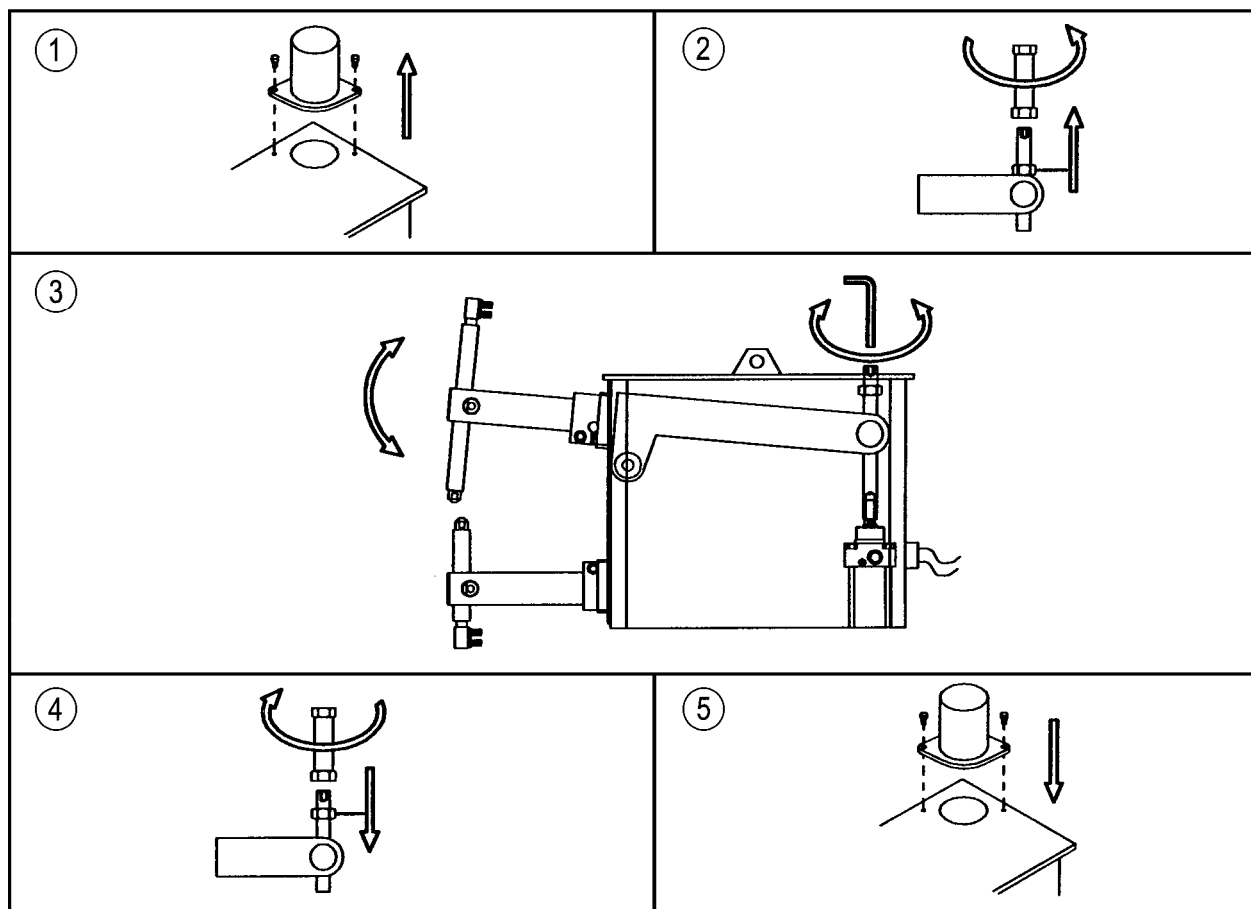
Adjust working stroke as short as possible to get:

- Higher productivity.
- Higher working precision.
- Reduced chance of accident.

The working stroke can be adjusted by carrying out the following operations:

- 1) Remove the safety protection 39360.
- 2) Slacken lock nut 10262 by means of the box wrench supplied with the standard accessories.
- 3) Adjust the working stroke by turning the cylinder stem by means of an Allen key, 8 mm. The adjustment is carried out considering that, when clamping the pieces to weld, the arms must be in a parallel position.
- 4) Carefully tighten nut 10262.
- 5) Assemble again safety protection 39360.

The stroke limiting device 70146, placed on the welder front side, enables adjustment of the foot control and thus to reduce the working stroke. Set it up to get the foot control desired height.



4.2 ELECTRODE FORCE ADJUSTMENT

The welding force must be selected taking into consideration both tables and personal experience, and in relation to the sheets thickness, the desired spot quality, etc.

An excessive electrodes force can cause:

- Leave weld marks.
- Shorten electrode life.
- Weak welding or false welding due to a reduction of the contact resistance, which allows the current to pass through without bringing the piece to the melting temperature.

An insufficient force on electrodes can cause:

- Spatters of melted material.
- Stuck weld of the pieces on the electrode.
- Cosmetically bad outside surfaces.

The electrode force is adjusted by operating on screw 10371, which alters the load on a spring. The electrode force cannot be measured unless one has a dynamometer. If this is not the case, the adjustment has to be made by trail and error, effecting test welds on material similar to that one to be welded.

4.3 WORKING PROGRAM ADJUSTMENT

This operation enables to choose the welding parameters and to enter them directly on the welding control. Select parameters from tables or personal experience, taking into consideration the plate thickness, the welding desired quality etc. It is recommended to cut coupons of your material and make sample welds to help determine your parameter values.

We suggest to use short welding times to reduce the electrodes heating, thus increasing their life, at the same time avoiding oxidation on the contact surfaces. The best quality welds are obtained by using times as short as possible with high current and high electrode force. Notice that when operating pieces with different thickness, the welding parameters to be used are those which refer to the lower thickness.

We recommend to set SQUEEZE parameter to 1=5 cycles.

Parameters HOLD and OFF, not used on this welder, can be set to 0.

When the current has stopped, the electrodes must be kept closed for a few moments, this to avoid the spot being stressed before sufficiently cooled. This precaution enables to improve the weld quality.

4.4 CALCULATION OF THE MAXIMUM WELDING RATING

Before starting the production, it is necessary to check that the welding rating does not exceed the maximum welding rating allowed by the welder in comparison with the set welding conditions (time and current), otherwise causing a too high over heating.

To carry out this test, it is necessary to know the used welding current which must be measured with an adequate welding ammeter.

The welder maximum welding rating is the function of the thermal load applied to the welder itself, depending from both the used time and welding current and from the numbers of welds for unit of time. With these different parameters it is possible to define the I_{th} value, that is the "equivalent thermal current at the duty cycle of 100%". Its value is calculated as follows:

$$I_{th} = \sqrt{\frac{\text{welding cycles per minute} \times (\text{welding current in kA})^2}{3600}}$$

The resulting value must be lower than the welder maximum one; this value is stated on the "Technical Features" paragraph. On the contrary, it is necessary to reduce the welding rate.

When two different welding programs are employed, the value of the two welds must be calculate separately, then added in order to obtain the equivalent total value.

Example 1: Single welding program

Welding current = 8000 A, welding time = 18 periods, 5 welds per minute.

$$I_{th} = \sqrt{\frac{(18 \times 5) \times (8000)^2}{3600}} = 1265A$$

Example 2: Two different welding programs

2 welds per minute with welding current = 9000 A, welding time = 13 periods;
6 welds per minute with welding current = 5000 A, welding time = 8 periods

$$I_{th1} = \sqrt{\frac{(13 \times 2) \times (9000)^2}{3600}} = 765A$$

$$I_{th2} = \sqrt{\frac{(8 \times 6) \times (5000)^2}{3600}} = 578A$$

$$I_{th} = I_{th1} + I_{th2} = 765 + 578 = 1343A$$

5 SAFETY RULES

For a safe welder operation, the installation must be carried out by specialized personnel following all the instructions stated on the "INSTALLATION" chapter.

The welder maintenance must be carefully carried out by following all the safety instructions stated on the "MAINTENANCE" chapter.

The welder should be operated by trained personnel only; in any case, **users operating the welder must be aware of the possible risks and must have both read and understood this manual.**

Only authorized personnel can carry out the welder adjustment. The welder adjustments affect the operative safety so much so that they must be carried out by qualified personnel only.

Carefully follow the instructions stated on the "WORKING PROCESS" chapter.

It is forbidden to have multiple people working on the welder at the same time.

Only the operator should be in the work area during machine operation.

It is necessary to pay attention to the movement of the movable components. It is suggested to adjust the working stroke to the minimum allowed value and avoid working with the hands nearby the electrodes.

In case of water entering the welder, immediately stop the electrical supply.

Notice that these types of machines generate strong magnetic fields attracting metals and damaging watches, magnetic cards and magnetic data storage media. Since these magnetic fields can affect pace-makers, the wearers must consult their doctor before approaching to the welding area.

The personnel must wear both safety glasses and gloves. Avoid wearing rings, metal watches and clothes with either metal accessories or components.

When operating heavy working, high thickness and pieces with a difficult coupling, wear safety shoes and aprons, and use protection screens to protect the operator from possible spatters of melted materials. The safety shoes must be worn each time the pieces, because of their shape or weight, bear risks requiring them.

Keep the welder nearby working area free from flammable materials. In case the material to be welded produces either smoke or exhalations, install a proper aspirator in a well ventilated area.

In addition to the information stated on this chapter, always operate in accordance with all the relevant laws in force.

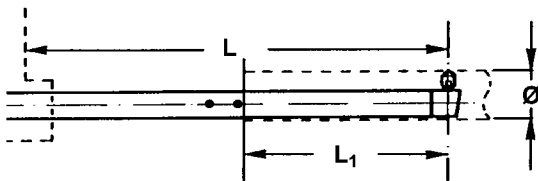
6 ACCESSORIES AND SPARE PARTS REQUEST

When ordering accessories, spare parts or expendable material please always state: type of machine, year of manufacture, serial number, the voltage and frequency of the welder they must be assembled on.

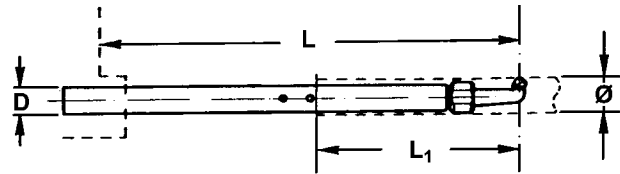
Available accessories:

- 70379 Additional electric foot for carrying out welding processes with direct recall of welding program no. 2, equipped with stirrup for the connection to the main foot. Cable L=1.4 m.
- 4566 Brass arm with reduced overall dimensions, $\varnothing = 65$, D=40, $L_1 = 300$ mm, L=380 ÷ 700 mm.
- 4569 Brass arm with reduced overall dimensions with frontal electrode, $\varnothing = 50$, D=40, $L_1 = 300$ mm, L=380 ÷ 700 mm.

Item 4566



Item 4569



Check LORS Machinery catalog for additional accessories and expendable materials.

7 MAINTENANCE

7.1 ORDINARY MAINTENANCE

This chapter states the necessary maintenance operations to be carried out for:

- 1) Keeping the welding unit safe operating and preserving its efficiency
- 2) Avoiding the most common causes of improper operation causing poor weld quality.

GENERAL WARNINGS



Always disconnect both electrical supply before carrying out the following maintenance operations.

- Always keep the screws of both arm, electrode holders, and rigid/flexible connections well tightened.
- Remove possible oxidation from secondary circuit with fine sandpaper.
- Periodically lubricate with grease and some drops of oil the joints 30107-30107-30521-30382.
- Keep welder clean from dirt and metal scraps attracted by magnetic field generated by the welder during the operation.
- Never wash the welding unit with jets of water which could enter it, or use strong solvents, thinner, or benzine that could damage either painting or the machine plastic components.

ELECTRODES MAINTENANCE



Electrodes maintenance must be carried out with the welder switched off.

- When operating, the electrodes must be kept clean and their diameter must be kept suitable for the work to be carried out. Worn electrodes must be dressed or replaced.
- When replacing electrodes, check that the tube bringing water to the electrode inside stops at a few mm(s) from the bottom of the electrode hole.
- Do not use sealing products to remove water leakage on the electrode taper. To facilitate the electrode removal and to prevent from both taper seizure and leakage, use high conductivity grease..

COOLING CIRCUIT MAINTENANCE



Cooling circuit maintenance must be carried out by specialized personnel only, trained to accomplish it under safety conditions. When possible, maintenance must be carried out with the welder disconnected from both electric and pneumatic supply.

- Check that cooling water circulates freely and in the required quantity, and that the input temperature is included within 10 and 30°C.
- Check the status of both water hoses and corresponding connections.
- If, during the winter terms, the welder must be stored up in cool rooms, it is necessary to carefully drain the cooling circuit to prevent from possible damages caused by frozen water.

ELECTRIC CIRCUIT



Electric circuit maintenance must be carried out only by specialized personnel trained to accomplish it under safety conditions. Disconnect electric mains before carrying out the following instructions.

- Periodically check the ground efficiency.
- Check the power supply cable status.
- Often check the proper functioning of the machine, the microswitch has to be triggered at least 1 inch before the pedal touches the ground.

7.2 EMERGENCY CONDITIONS WARNINGS

In case of emergency, turn off the main switch immediately stopping the welder working.

In case of any water leakage which could enter the welder, immediately disconnect the electric supply.

In case of fire do not use water but proper fire extinguishers.

The placing in service of the welder after an emergency condition must be carried out only by qualified personnel trained to accomplish all the machine necessary tests.

If the machine stopped during the welding process, it is necessary to execute the following procedure before restart the production in order to restore the normal transformer magnetization condition: carry out some welds with an insulator placed between the electrodes with different current adjustments, first low ones, then progressively higher; remove the insulator between electrodes and execute some welds with a low current adjustment; at this point the procedure ends and the normal functioning conditions are restored.

7.3 EXTRAORDINARY MAINTENANCE

This chapter states the maintenance operations to be carried out in case of:

1. lowering of the welder performances
2. welder not operating correctly
3. welding faults.

7.3.1 LOWERING OF THE WELDING UNIT PERFORMANCES



Extraordinary maintenance must be carried out by specialized personnel only, equipped with the proper instruments and trained to accomplish it under safety conditions. When possible, the welder must be disconnected from the electric supply.

If the performances are lower than expected, check:

- That, when welding, line voltage drop is lower than 15%.
- That the supply cables section is adequate.
- That the electrodes diameter is appropriate for the work to be carried out.
- That cooling water circulates in the required quantity.

7.3.2 TROUBLESHOOTING



Troubleshooting must be carried out by specialized personnel only, equipped with the proper instruments and trained to accomplish it under safety conditions. When possible, disconnect the electric supply.

In case of a malfunctioning welder, follow the instruction stated on table 1 to find out both fault cause and remedy.

Table 1 - Troubleshooting.

FAULT	CAUSE	REMEDY
The control unit does not switch on. Control unit led ON does not light.	Inadequate or no mains voltage.	Check.
	Either connectors or cables disconnected.	Check.
	Fuse FU1 blown.	Replace it.
	Faulty main switch.	Check and eventually replace it.
	Faulty control unit.	Replace it.
The control unit does not switch on. Control unit led ON is on.	Inadequate mains voltage.	Check.
	Faulty control unit.	Replace it.
During the welding, the machine stops the welding current.	Too high voltage drop.	Check that, when working, voltage drop is lower than 25%. On the contrary, check that supply cables section is adequate to their length.
The welder does not carry out the welding. Control unit START led lights by pressing foot-control. Control unit CURRENT led is off during the welding cycle.	WELD/NO WELD function set to NO WELD	Set to WELD.
	Faulty control unit.	Replace it.
The welder does not carry out the welding. Control unit START led does not light by pressing foot-control.	The foot-control does not activate the start cycle micro-switch. Faulty set up of the force adjusting screw.	Check.
	Either disconnected connectors or cables.	Check.
	Faulty micro-switch.	Replace it.
	Faulty control-unit.	Replace it.
The welder does not carry out the welding. Control unit START led lights by pressing foot-control. Control unit CURRENT led lights during the welding cycle.	Thermostat ST1 placed on SCR activated.	Check that water circulates in the required quantity and/or check the correct thermostat working.
	Either SCR or firing module malfunctioning. Firing modules led shows the presence of SCR trigger signals.	Identify the faulty component and replace it.
	Faulty contact in the secondary circuit.	Check, tighten and all the secondary connections. Do not forget the electrode and electrode-holder connection.
Spots or electrodes overheating.	Insufficient cooling.	Check that water circulates in the required quantity and at a low temperature.
	Too high welding current or welding time.	Reduce them.
Electrodes reduced life.	Insufficient cooling.	Check that water circulates in the required quantity and at a low temperature.
	Under-sized electrode in comparison with the work to carry out.	Check both size and contact diameter.
Secondary connections reduced life.	Insufficient cooling.	Check that water circulates in the required quantity and at a low temperature.
	Heating caused by an inadequate clamping of the flexible connection.	Carefully tighten the clamping screws.
	Too high heating caused by a too high welding rate.	Reduce it.

7.3.3 REMEDIES FOR WELDS IMPERFECTIONS

This chapter has been introduced in order to facilitate the troubleshooting of the most common imperfections caused by a wrong adjustment. Notice that each fault can be caused by different causes, as there are many parameters affecting the welding process. The following table specifically refers to low carbon steel spot welding, but, with the due considerations, it can be usefully used also for other applications.

FAULT	POSSIBLE CAUSE	POSSIBLE REMEDY
Weak welding	Low welding current.	Increase it.
	Low welding time.	Increase it.
	Too high electrodes force.	Reduce pressure.
	Lacking electrodes maintenance or too high electrodes diameter.	Clean and line up the electrodes, restore their dimensions.
	Faulty pieces contact.	Increase the electrodes force.
Spatters of melted material	Paint or dirt among pieces.	Clean the pieces.
	Inadequate electrodes cooling.	Check the cooling circuit.
	Faulty pieces contact or pieces and electrodes faulty contact.	Increase the electrodes force by increasing pressure.
	Too high welding current.	Reduce it.
	Too high welding time.	Reduce it.
	Too small electrodes diameter.	Adjust diameter to the value shown on the table.
	Inadequate welding force.	Increase pressure.
	Electrodes faulty clamping of the pieces.	Check stroke.
Burned welds or welds showing either craters or fissures.	Too high welding current.	Reduce it.
	Inadequate welding force.	Increase welding pressure.
	Oxidized pieces to weld.	Clean them by means of emery paper.
	Faulty pieces contact or pieces and electrodes faulty contact.	Increase electrodes force.
	Faulty pieces lining up.	Correct it.
	Electrodes tips deformations.	Restore them to the correct size.
Pieces stuck weld on the electrode.	Too high welding current.	Reduce it.
	Inadequate electrodes diameter.	Restore it to the correct dimensions.
	Inadequate welding force.	Increase the welding pressure.

8 ENCLOSURES

8.1 WELDING TABLES

In order to facilitate the search for the best welding conditions, we have inserted the following tables stating the approximate adjusting values. Notice that the same weld can be carried out under different working conditions, so much so that the following data are not binding ones.

Low Carbon Steel Spotwelding

Welding class A

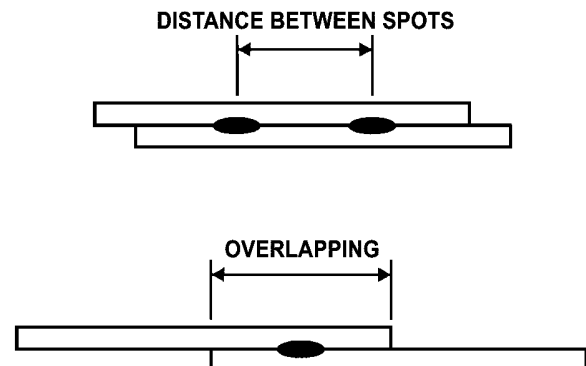
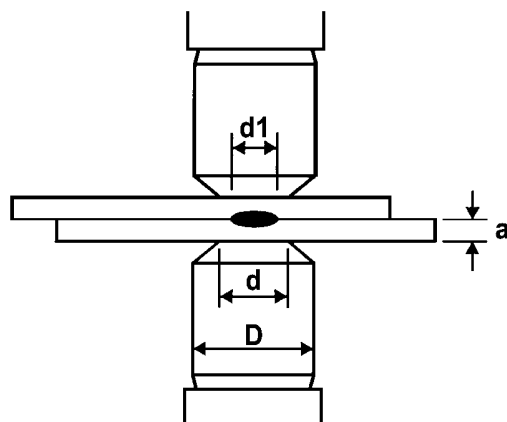
Thickness a inches	Spots min. distance inches	Minimum overlapping inches	Electrodes		Electrodes force pounds	Welding current kA	Welding time cycles	Obtained nugget d1 inches
			D min inches	d max inches				
.010	1/4	3/8	1/2	1/8	200	4	4	.13
.021	3/8	7/16	1/2	3/16	300	6.1	6	.17
.031	1/2	7/16	1/2	3/16	400	8	8	.21
.040	3/4	1/2	5/8	1/4	500	9.2	10	.23

Welding class B

Thickness a inches	Spots min. distance inches	Minimum overlapping inches	Electrodes		Electrodes force pounds	Welding current kA	Welding time cycles	Obtained nugget d1 inches
			D min inches	d max inches				
.010	1/4	3/8	1/2	1/8	130	3.7	5	.12
.021	3/8	7/16	1/2	3/16	200	5.1	10	.16
.031	1/2	7/16	1/2	3/16	275	6.3	15	.20
.040	3/4	1/2	5/8	1/4	360	7.5	21	.22
.050	7/8	9/16	5/8	1/4	410	8	24	.23
.062	1	5/8	5/8	1/4	500	9	29	.26

Welding class C

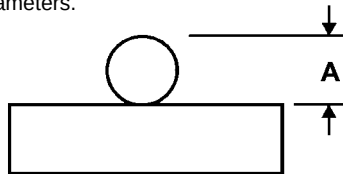
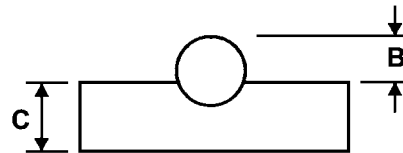
Thickness a inches	Spots min. distance inches	Minimum overlapping inches	Electrodes		Electrodes force pounds	Welding current kA	Welding time cycles	Obtained nugget d1 inches
			D min inches	d max inches				
.021	3/8	7/16	1/2	3/16	100	3.8	22	.14
.031	1/2	7/16	1/2	3/16	135	4.7	29	.18
.040	3/4	1/2	5/8	1/4	180	5.6	38	.21
.050	7/8	9/16	5/8	1/4	205	6.1	42	.22
.062	1	5/8	5/8	1/4	250	6.8	48	.25
.078	1 1/8	11/16	5/8	5/16	325	7.9	58	.28
.094	1 1/4	3/4	5/8	5/16	390	8.8	66	.31
.109	1 5/16	13/16	7/8	3/8	480	9.5	72	.35



Crossed Rods Welding of Cold Drawn Low Carbon Steel

Rod diameter inches	Set-down 15%		
	Welding time cycles	Electrodes force Lbs.	Welding current kA
1/16	5	100	0.6
1/8	10	125	1.8
3/16	17	360	3.3
1/4	23	580	4.5

N.B. In the welding of reinforced concrete rods there are cases in which the same parameters can be used to weld different, much higher, diameters.

**BEFORE WELDING****AFTER WELDING**

$$\text{SET-DOWN} = \frac{A - B}{A} \times 100$$

8.2 PRODUCTION FORM FACSIMILE**FIRM DATA**

Company	Department
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WELDER DATA

Welder Model	Number
Welding transformer connecting positions	

PIECE TO BE WELDED

Description	
Code	Thickness
Material	Coating

WELDING PARAMETER ADJUSTMENT

Reached welding current kA	
Working stroke adjustment mm	Arms length adjustment mm

**WELDING CONTROL UNIT
TE90 PARAMETERS**

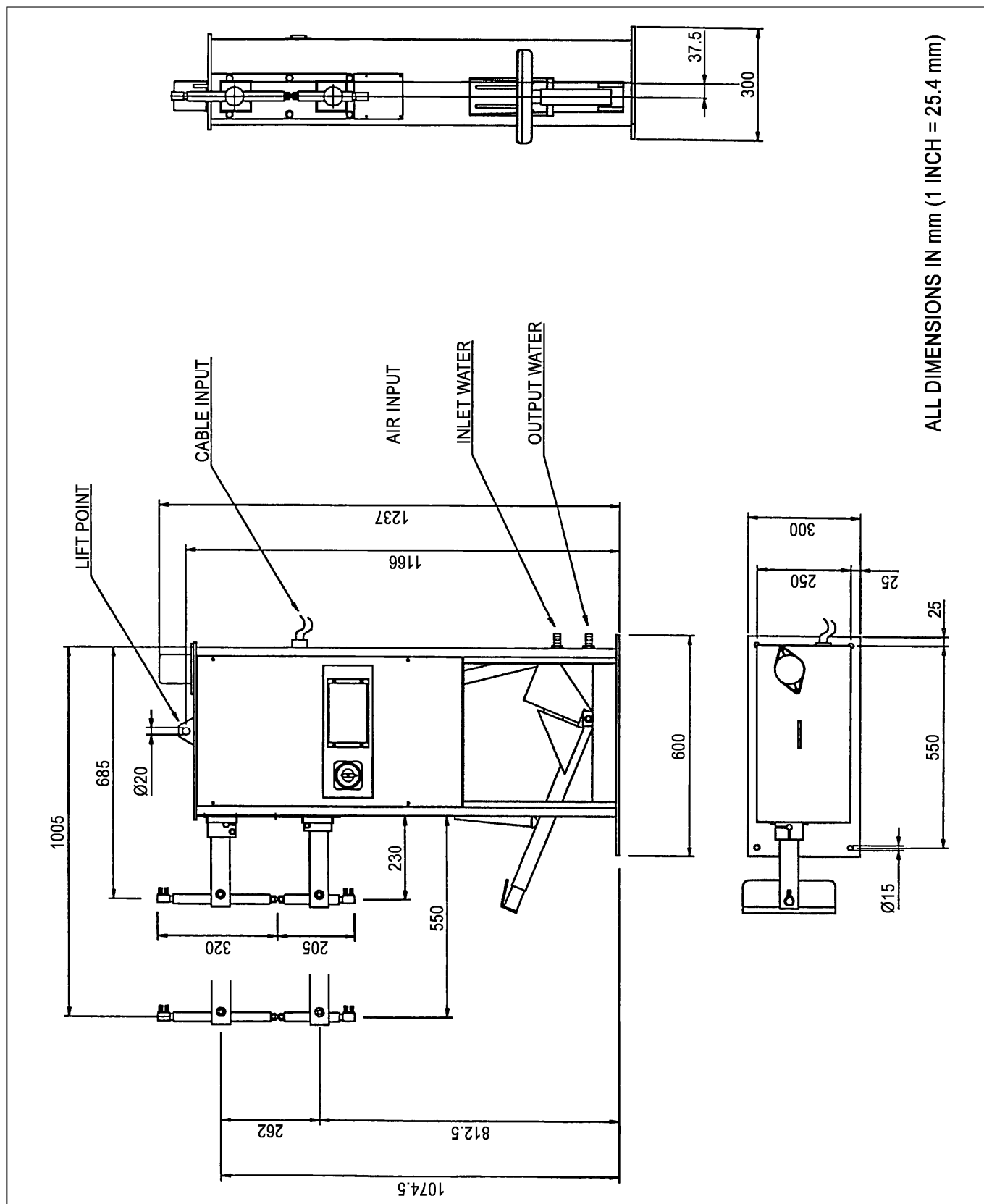
PARAMETER	VALUE
SQUEEZE	
WELD TIME	
CURRENT	
HOLD	
OFF TIME	
COMP. / NO COMP.	
WELD / NO WELD	
WELD TIME 2	
CURRENT 2	
SLOPE	
COLD TIME	
IMPULSE NUMBER	

NOTES CONCERNING EITHER ELECTRODES OR WELDING TOOLS

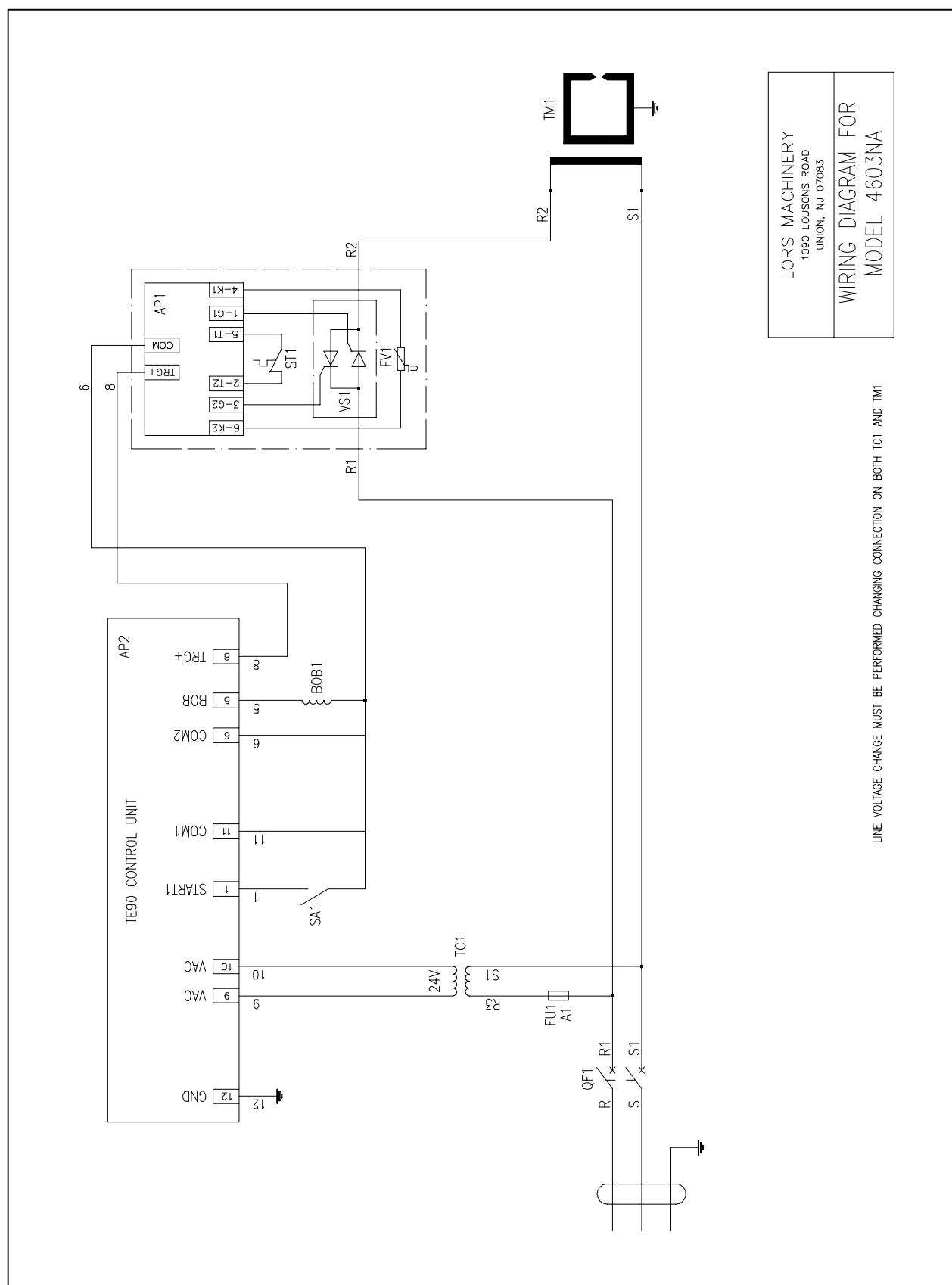
(Electrode type and diameter, maintenance and electrode replacement terms, etc.)

9 TECHNICAL DOCUMENTATION

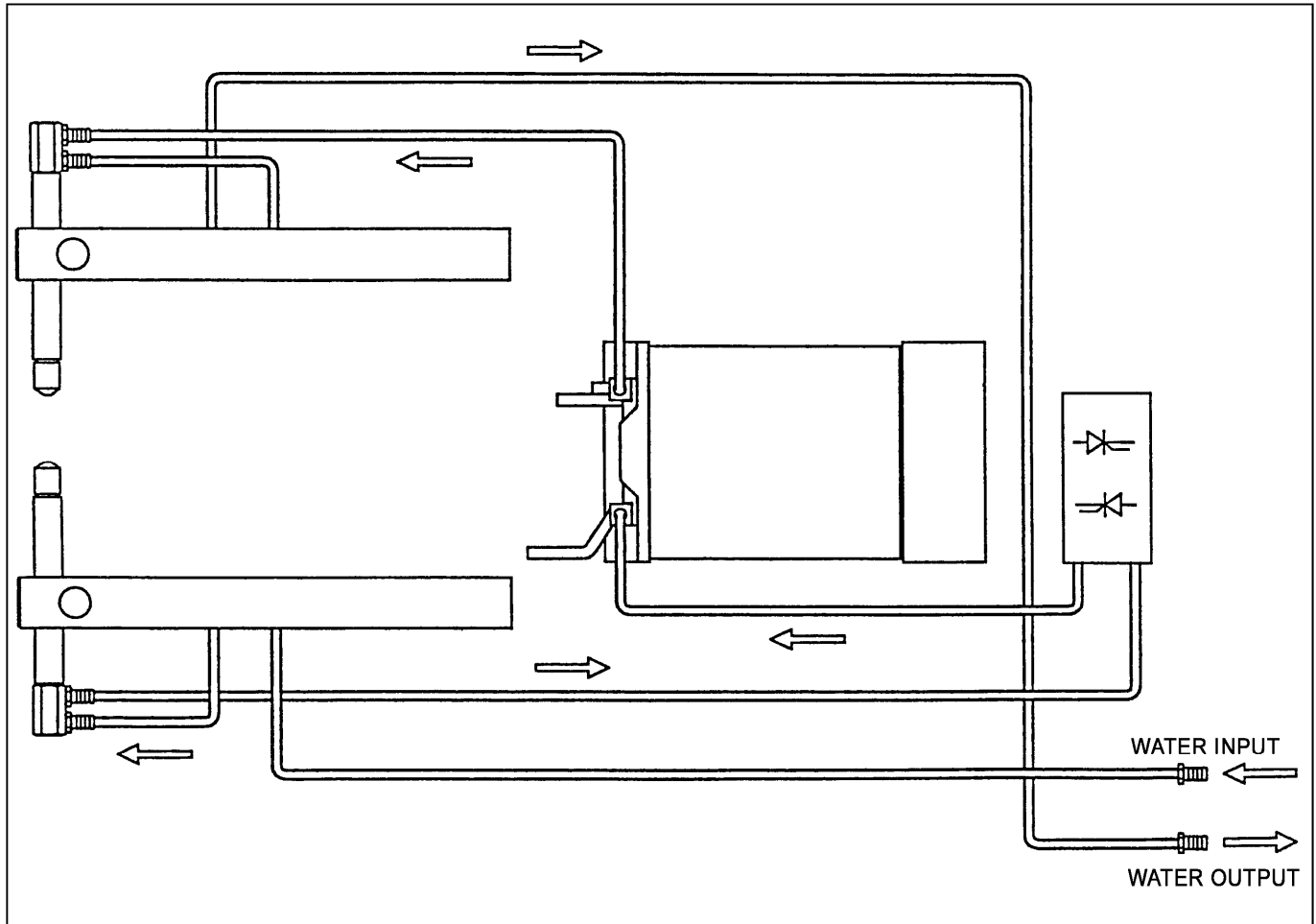
The following technical documentation is addressed to the factory responsible in charge and to the personnel in charge of both welder installation and maintenance. It contains useful information for carrying out these operations.



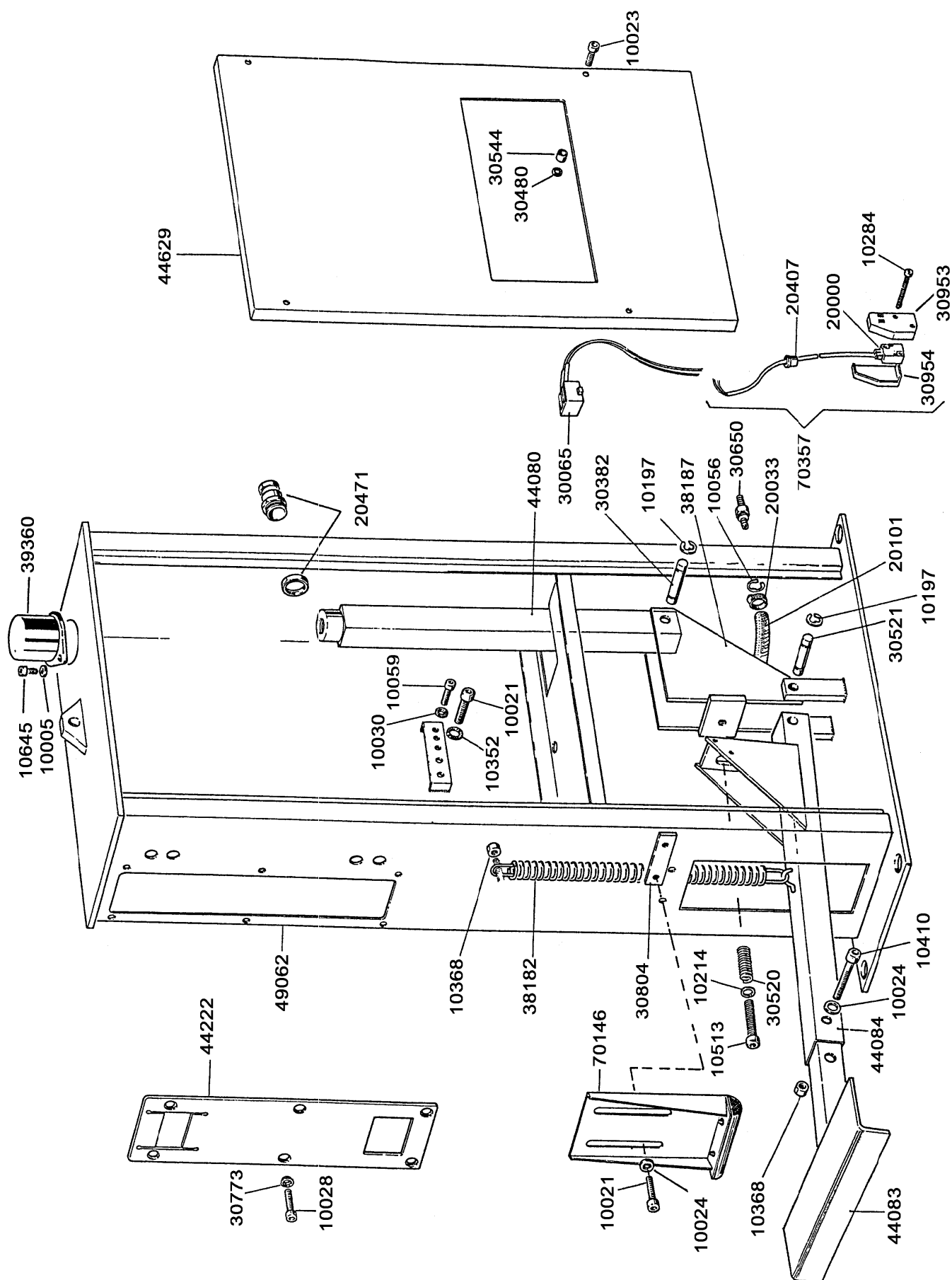
Machine Overall Dimensions

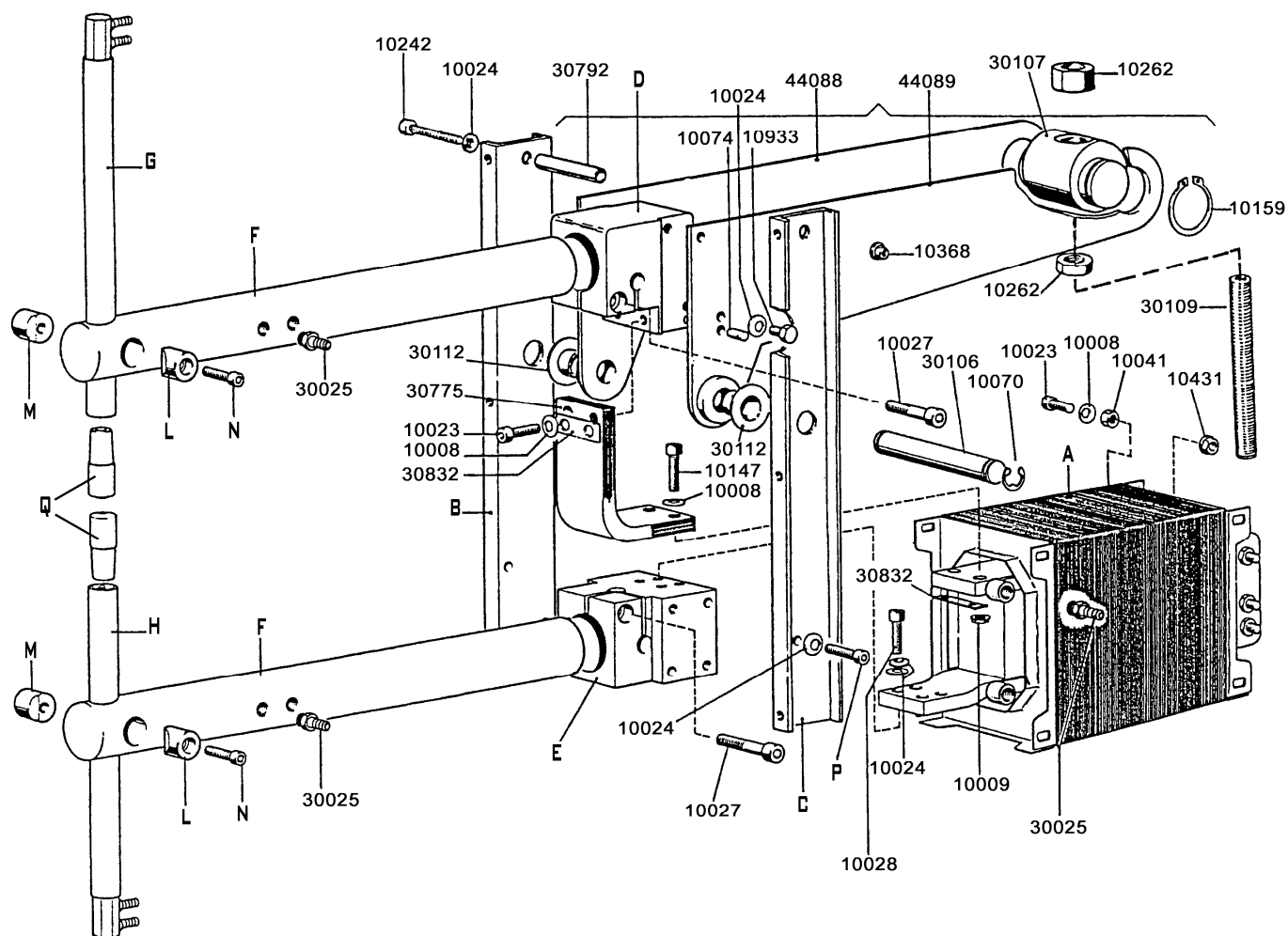


Electrical Drawing



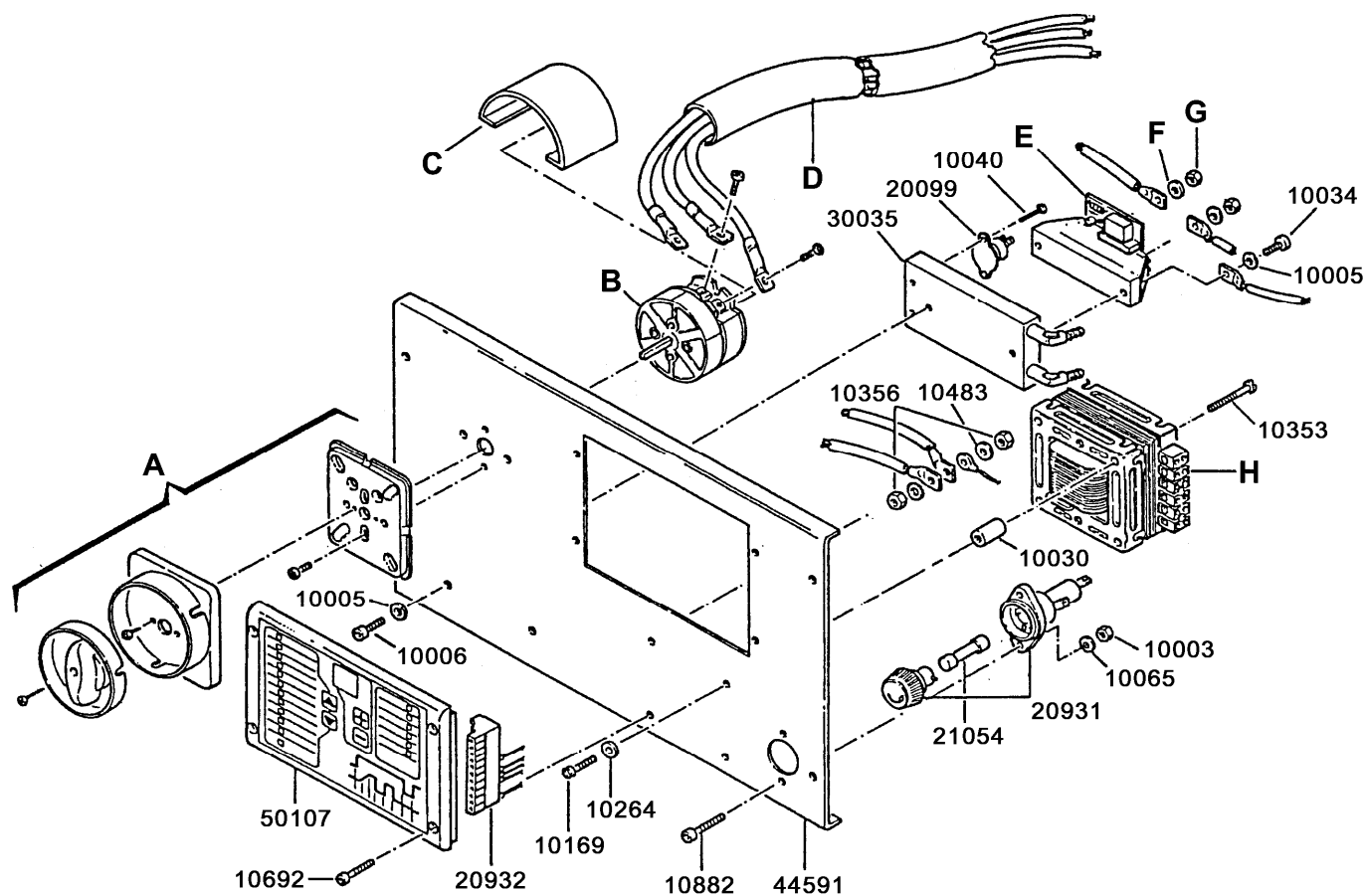
Cooling Circuit Drawing





POWER SUPPLY	TRANSFORMER “A” PART NUMBER	
	4603NA	4604NA
220/440 V 60 Hz	47276	47276

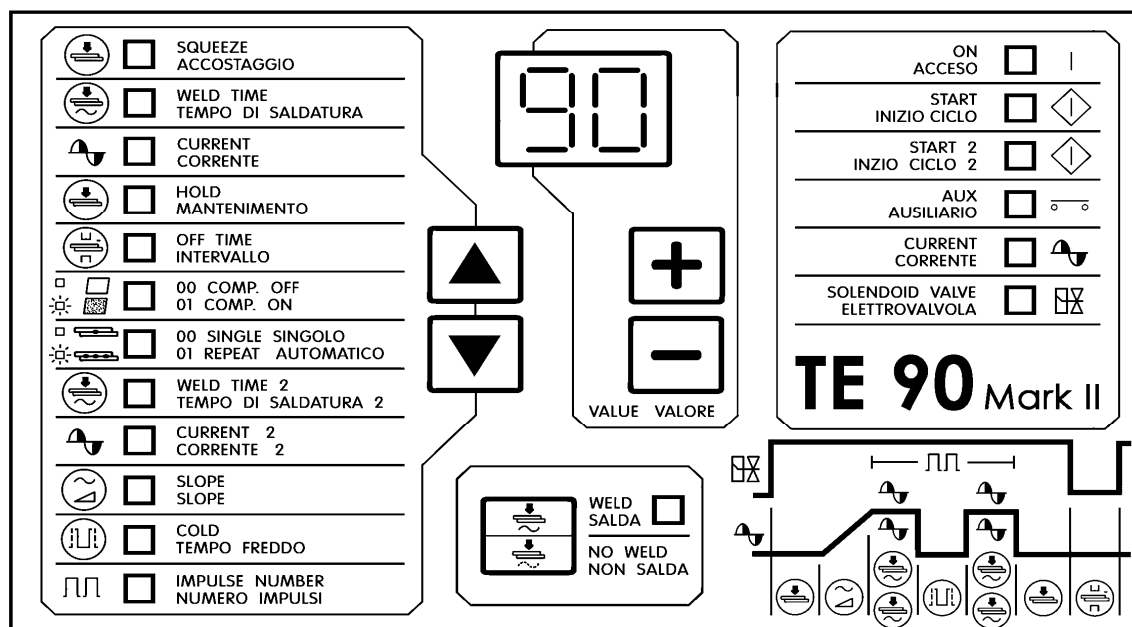
REFERENCE		PART NUMBER	
		4603NA	4604NA
B	Left bracket	44086	44086
C	Right bracket	44087	44087
D	Upper arm holder	38395	38395
E	Lower arm holder	38396	38396
F	Arm	44868	34839
G	Upper electrode holder	SHN-08084	SHN-08084
H	Lower electrode holder	SHN-08084	SHN-08084
L	Locking	30513	30513
M	Locking	30512	30512
N	Screw	10410	10410
P	Screw	10021	10021
Q	Electrode	A2408	A2408



REFERENCE		PART NUMBER	
		4603NA 220/440 V	4604NA 220/440 V
A	Knob	20922	20922
B	Switch	20326	20326
C	Screen	21214	21214
D	Cable	20225	20225
E	Thyristor	50121	50121
F	Washer	10483	10483
G	Nut	10356	10356
H	Transformer	38498	38498

10 CONTROL DOCUMENTATION (TE90)

TE-90 is a microprocessor welding control unit for single-phase resistance welders. The welding control unit is used to control the welder parts and, in particular, the thyristors adjusting the welding current. The working cycle carried out by the TE-90 is described through the programming parameters. The TE-90 can be used for both manual and pneumatic-operated welders.



MAIN FEATURES

- Synchronous thyristor drive.
- Phase shift control for welding current adjustment.
- Simplified programming by means of four push-buttons.
- Twin pre-setting for time and current, recallable by two independent controls.
- Slope and pulse functions.
- Single and repeat operating mode.
- Secondary current compensation function for welding of oxidized sheets and rods.
- Auto-retain disabling for manually operated welders.
- First phase shift delay adjustment. It enables the machine line current best balance.
- Control of solenoid valve 24 Vdc 7,2 W Max with protected output against short circuits.

TECHNICAL DATA

Electronic circuit supply:	24 Vdc +10% / -20% 50/60 Hz.
Consumption:	7 VA at rest 21 VA when welding
Operative temperature:	5 ÷ 40 °C

PROGRAMMING THE WELDING CONTROL UNIT

Straight after the control unit is switched on, the display shows the program version; after a few seconds the TE-90 equipment is set in a waiting condition enabling the operator either to carry out the programming or any welding process. The control unit is programmed through the regulation of all parameters describing the welding cycle; select the

parameters and set the desired values one by one. (See the relevant paragraph to better understand the meaning of each parameter.)

The parameters are marked with international symbols which are listed on the left side of the control unit. Each parameter is combined with a pilot light. Select the parameters by means of push-buttons ▲ and ▼, the pilot light corresponding to the selected parameter lights on and its value is shown on the display.

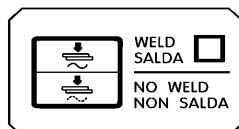
Change the welding parameters value by means of push-buttons + and - , thus increasing or decreasing the value shown on the display. The parameters can be set to different values, according to the type of parameter. The minimum and maximum limits of each parameter are described in the following table.

PARAMETER	RANGE
SQUEEZE	1-99 cycles
WELD TIME	1-99 cycles *
CURRENT	1-99%
HOLD	1-99 cycles
OFF TIME	1-99 cycles
COMPUTER OFF/COMPUTER ON	00-01
SINGLE/REPEAT	00-01
WELD TIME 2	0-99 cycles *
CURRENT 2	0-99%
SLOPE	0-29 cycles
COLD	1-50 cycles
IMPULSE NUMBER	0-9

* When the pulse function is used, that is when the IMPULSE NUMBER is other than 0, the welding time should not exceed 25 periods. If this condition is not observed, an error is signaled.

In this way all the parameters are set to the desired value. Please notice that it is not necessary to press any push-button to confirm the set value, as this is automatically stored up after the adjustment. When programming step is over, it is possible to use the welder without previously confirming the set or the stored data.

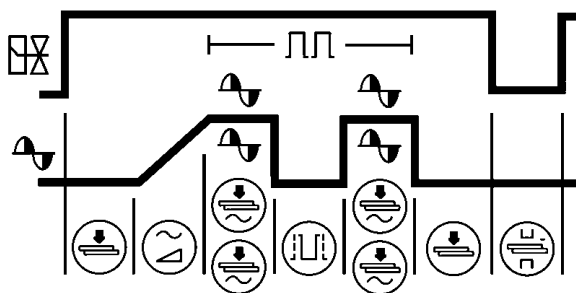
Use the WELD/NO WELD function to carry out any test cycle without welding current. By means of the here shown proper key, it is possible to enable or disable the welding current. When the light is on, the control unit is set to WELD and it carries out standard welding cycles. When the light is off, the complete test cycles without welding current, even though all the time-relevant parameters are preserved.



During the welding cycle the control unit shall display both the current function and the relevant value.

DESCRIPTION OF THE WORKING CYCLE

The TE 90 working cycle is described by the user through the regulation of all programming parameters. These parameters indicate the operating times and the current adjustments characterizing the working cycles whenever performed consecutively. The following chart shows the order the programmed functions are carried out.



The symbols refer to the programming parameters described in the following paragraph.

Due to safety reasons, the microprocessor does not start the welding cycle when the cycle start signal is enabled during the welder connection; in this case, disable the control and then enable it again.

Any micro-interrupts or excessive voltage drops block the control, rather than altering the operation; to reset the operation, turn the machine off and then turn it on again.

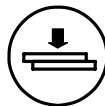
DESCRIPTION OF THE PARAMETERS

All the following parameters indicating a period of time are expressed in mains cycles, also called periods. The mains frequency defines the length of a cycle:

Mains frequency of 50 Hz 1 period = 20 ms
Mains frequency of 60 Hz 1 period = 16,6 ms

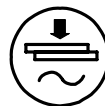
SQUEEZE

The SQUEEZE time is the time interval elapsing between the beginning of the electrode movement and the beginning of the welding cycle. The set value should be long enough to allow the electrodes to reach the correct tightening force before the beginning of the welding process. An insufficient regulation of this time causes the formation of flashes between the electrodes and the sheet at the beginning of the welding process; this inconvenient could lead to an unsteady quality level. Should the cycle start signal be disabled during the squeeze time, then the sequence is interrupted.



WELD TIME

The WELD TIME parameter indicates the current flow duration. It will be carried out with the power value indicated in parameter CURRENT. When the pulse operation is on, this parameter signals the duration of each pulse.



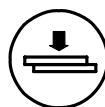
CURRENT

The value expressed in CURRENT indicates the welding operating power.



HOLD

The HOLD parameter describes the time elapsing between the end of the welding process and the opening of the electrodes. It enables a shorter cooling of the welding spot and avoids its stress before a proper cooling.



OFF TIME

The OFF TIME parameter describes the machine waiting time elapsing between one machine cycle and the other when the welder is used in repeat mode (SINGLE/REPEAT set to 01).

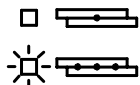


COMP. OFF / COMP. ON

By setting this parameter to 01 the secondary current compensation function is enabled. By setting the parameter to 00 the function is disabled.

When working, the relevant led shows that this function is activated.



SINGLE / REPEAT

By setting this parameter to 00 the machine will operate in SINGLE mode: the control unit carries out only one welding cycle whenever a cycle start signal has been received. By setting this parameter to 01 the machine will operate in REPEAT mode: the welder will go on carries out welding cycles until the cycle start signal is released. Welding cycles are repeated with a time interval as defined in parameter OFF TIME. When working, the relevant led shows that REPEAT mode is activated.

WELD TIME 2

Should the cycle be enabled with the cycle start signal START 2 (by means of either a second foot control or a proper selector) the control unit carries it out considering this welding time adjustment instead of the one set in the WELD TIME parameter. If this time is set to zero, then the control unit will carry out the welding cycle following the main parameters.

CURRENT 2

The CURRENT 2 parameter indicates the welding power adjustment whenever the cycle has been carried out starting from the second start of cycle signal START 2. If this parameter is set to zero, the control unit will perform the welding cycle following the main parameters.

SLOPE

The SLOPE parameter describes the time used to reach the programmed welding current. The initial value of this slope always corresponds to the minimum current value, while the final value corresponds to the current value programmed in parameter CURRENT or CURRENT 2. The slope of this parameter is automatically calculated by the microprocessor according to the programmed values.

COLD

The COLD parameter is used in the pulse operating mode and indicates the time elapsing between one welding pulse and the next one.

IMPULSE NUMBER

The IMPULSE NUMBER parameter indicates the number of impulses used to carry out the welding process. When this parameter is set to 0, the pulse operation is disabled. The length of each impulse corresponds to the time set in the WELD TIME or WELD TIME 2 parameter. When working, the relevant led shows that this function is activated.

COMPENSATION FUNCTION OF SECONDARY CURRENT

The compensation function of secondary current is used to facilitate the welding process of oxidized sheets and rods. The pieces oxidation blocks the current flow during the first welding phase, thus limiting, in a different way depending from the welding process, the real time of current flow. The compensation function controls the welding current by means of a coil located inside the secondary circuit. Until the welding current does not exceed a pre-set limit, the welding time is automatically extended up to a limit of 99 cycles. In this way it is possible to carry out welding processes with an always constant real time of current flow.

If, after having reached the 99 welding periods limit, the current limit is not exceeded, the control unit will indicate that the welding process has not been correctly carried out by displaying the E4 error, and will block the welder functioning. To restore the functioning, press a push-button. The current limit is adjusted, by means of an internal trimmer, by the welder manufacturer. The standard value is usually about 1500=2000 A. By means of JP2 jumper, located on the card, is possible to disable this function:

COMPENSATION	JUMPER JP2
ON	OPEN
OFF	CLOSED

DELAY FUNCTION OF FIRST PHASE SHIFT

This function allows to obtain the best machine line current balance. Simultaneously press push-buttons and for about one second to carry out the adjustment. The CURRENT function lamp flashes and the display shows the actual set value. As usual, the adjustment is carried out by pressing push-buttons and . The value can be set from 35 up to 99. When the programming is over, press or . As this adjustment is carried out by the welder manufacturer, the user does not need to modify this value.

AUTO-RETAIN FUNCTION

As usual, when the current flow starts, the welding control unit ends the welding cycle even if the cycle start control is disabled. This function is called auto-retain function. In TE 90 it can be disabled to use the control unit for manual-operated welders. In this case, if the cycle start signal is disabled during the machine cycle, the control unit will immediately stop the welding current flow and disconnects the solenoid valve. In both cases the control unit immediately stops the cycle and opens again the electrodes whenever the cycle start signal is disabled during the squeeze phase. The auto-retain function selection is carried out through jumper JP1 located on the card:

AUTORETAIN	JUMPER JP1
ON	CLOSED
OFF	OPEN

While using electric-operated welders this function should always be enabled in order to prevent any welding cycle from having a welding time other than the set one.

CONTROL PANEL PILOT LIGHTS

ON ACCESO 	It signals that the mains voltage is on.
START INIZIO CICLO  	It signals that the main cycle start control is on.
START 2 INIZIO CICLO 2  	It signals that the additional cycle start control is on.
AUX AUSILIARIO  	It signals that the block control with pressure only is on. This input is activated by the first stage of a foot control or by other devices that should hinder the welding process (such as for example, flow switches, pressure switches or the interlocking system of another welder).
CURRENT CORRENTE  	It signals that the control unit is generating the control impulses for SCR.
SOLENOID VALVE ELETTROVALVOLA  	It signals that the solenoid valve is on.

ERROR LIST

MESSAGE	CAUSE	CURE
E 1	The value of one of the stored parameters exceeds the preset limits. This could be caused by a loss of data due to any interference or wrong functioning.	Press a push-button to cancel the error. Check all the values set in the parameters and correct them if necessary. Apply to the after-sale service if the trouble occurs frequently.
E 2	The welding time is set to a value higher than 25 and pulses operating mode is activated. This parameter cannot be higher than 25 in the pulse mode operation.	Press a push-button to cancel the error. Set the welding time to a value lower or equal to 25 cycles.
E 3	Pulses operating mode is activated and the total welding time (welding time x impulse number) is higher than the limit of 150 cycles. Do not exceed this value so as not to overheat the machine.	Press a push-button to cancel the error. Decrease the welding time or the impulse number so that their product is lower than 150 cycles.
E 4	The compensation function is enabled and the control unit has extended the welding time up to the maximum limit of 99 periods. The set welding time has not been carried out with a welding current higher than the limit.	Press a push-button to cancel the error. Before restart the welding process check the welding conditions. If the pieces are too oxidized they must be cleaned.